NGGPS Workshop
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NGGPS Sea Ice Modeling Workshop

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Developmental Testbed Center

http://www.dtcenter.org/events/workshops16/seaice/

Sea Ice Modeling Workshops

- **Context**: Back-to-back ONR Sea State and NGGPS sea-ice wkshps
- **Date and location**: 2-4 February 2016 at NCAR, Boulder, CO
- **NGGPS sea-ice modeling workshop committee**
  - J. Intrieri (NOAA, ESRL), M. Holland (NCAR), B. Grumbine (NOAA EMC), C. Bitz (U. Washington), R. Allard (NRL), and A. Mariotti (NOAA OAR/CPO), Eugene Petrescu (NOAA NWS AK)
- **Goals**: Review state-of-art and lessons from ONR SeaState initiative, candidate models for NGGPS, selection criteria, predictability, performance, skill metrics, testing considerations, R&D needs & opportunities for coordination, recommendations on the selection process

Participants: 65 registered

U. Washington
U. Toronto
U. Maryland
Princeton U.
Naval PS

UKMO
U. Reading
U. Toronto
Environment Canada

DTC
NCAR
CU/CIRES
NSIDC
NASA GMAO

NRL
ONR
LANL
US Natl Ice Center

NOAA: NCEP/EMC, ESRL GSD, ESRL PSD, GLERL, CPO, NWS Alaska

Information provided by EMC (H. Tolman, A. Mehra, B. Grumbine)

Review of deliverables for NGGPS

- **Sea ice model for a variety of time and spatial scales**
  - 5, 16, 30 days + beyond
  - O (1km) – O (25 km): NWP through seasonal, including ensemble
- **Number of sea-ice and ocean models at NCEP**
  - Hendrik: NCEP/UMAC supporting streamlining production suite. Unification of models IF it makes sense (could retain more than one model)
- **Seeking a fully coupled, community system**
  - Atmosphere, ocean, sea ice, waves etc.
- **Operationally stable**
  - No blow ups in middle of the night
- **<u>Need decision on sea-ice model by end of FY16 (Sep 2016)</u>**
  - Do not close the door to down-selected models – further test in coupled mode may bring more information

http://www.apl.washington.edu/project/project.php?id=arctic_sea_state

ONR Sea State & BL Physics of new Arctic

- Field campaign collected comprehensive obs
- Several synergistic short-term NWP efforts, such as
  - **NRL:** 2-km CICE+ HYCOM+WW3 forced by 15-km COAMPS
  - **ESRL-RASM:** CICE + mixed-layer ocean + 10-km WRF

Verification

- Need for unconventional metrics
- Address sources of errors (IC, fix files, parameters, model)
- Forecast post-processing is critical

Community Modeling

- Community models bring large potential for R2O: diverse group working on common problems
- A community model is a model used by community, not simply a model with code made available to community
- HWRF, MOM6, and CESM are examples of community codes, supported by DTC, GFDL, NCAR, respectively
- Requirements include open governance, code management that fosters contributions, modularity, support, documentation, peer-to-peer involvement
- Use of a community model by NCEP does not guarantee R2O:
  - Need to focus on common problems (funding helps)
  - Need relevant testing harness

Predictability: seeking single sea ice model with predictability at all time and spatial scale

From Cecilia Bitz (U. Washington)

Sea ice – autocorrelation timescales

- sea ice thickness distribution – year or so
- melt ponds – a few months
- floes size distribution – a month? (my guess)
- anisotropy (lead orientation) – a week

Subseasonal forecast (2-3 weeks):

Initialized with the current thickness, concentration, and floe & melt pond size statistics. The key external conditions that will determine the fast evolution is wind anomalies, and to a lesser extent SST anomalies. Forecast is primarily a coupled atmosphere-ice problem (with correct SST ICs).

Initialization is key!

Ice Models and Modeling Systems

Ice Models

Simplified physics

- **NWS Drift & KISS Models-** B. Grumbine (NWS NCEP)

Sophisticated physics

- **LANL CICE** – A. Turner (LANL)
- **UW PIOMAS** – A. Schweiger (UW)
- **GFDL SIS2** – M. Bushuk (NOAA GFDL) (uses some CICE physics)

Modeling Systems

- **U.S. Navy ACNFS/GOFS 3.1** – P. Posey (NRL) [HYCOM+CICE + offline atmos]
- **NCEP CFS v2** – X. Wu (NCEP) [GSM+MOM4+SIS]
- **NCEP -CFS v3** - D. Bailey (NCAR)[NEMS+GSM+MOM+CICE]
- **Canadian RIOPS** - Fred DuPont (EC) [NEMO+CICE]

Synergistic activities: CPO/CPTs, CESM, SIPN, ONR, GLERL, UKMO, etc.

Recommendation

- **Tradeoffs**
  1. Compare forecast results from various models?
  2. Use other criteria? Existence of community, documentation, support, etc.
     - Most sea ice models have state-of-the-art physics and are similar
     - Instead of investing in intercomparison, invest on testing/developing one model
- **Recommendation: test and possibly adopt CICE due to its extensive use in the community and excellent documentation and community resources**
- **Issues**
  - Intellectual property issues need to be addressed to make CICE a true community model - Governance must support NGGPS needs
  - Difference in grid staggering between ice/ocean/atmosphere can lead to undesirable results

Next steps

- **Short term (6 months)**
  - Workshop report will be prepared by committee and collaborators
  - Formation of tiger team to define and conduct CICE testing
- **Long term**
  - Continued testing and evaluation
    - Tap onto community scientists using variety of models
  - Observations for verification and DA: expand use
  - DA: critical for improving short-term NWP
  - More sophisticated vx/diag metrics that provide feedback to model developers (processes) and end users
  - Ensembles
  - Artic Testbed